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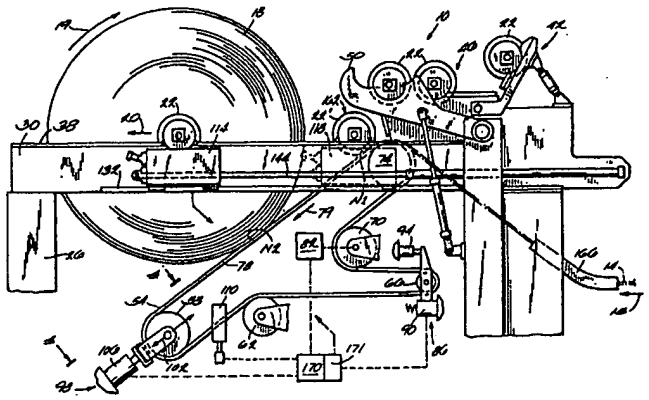

(57) Abstract

Apparatus (10) for reeling a traveling paper web (14) into a wound web roll (18) on a reel spool (22) having opposite ends, the apparatus comprising first and second generally parallel, generally horizontal rails (30, 34) each having an upper surface (38) for supporting a respective end of the reel spool, a support belt (54) mounted for movement along an endless path, the belt having an upper run (78) angled downwardly in the downstream direction (20), first and second carriages (114, 124) operatively associated with the first and second rails, respectively, for longitudinal movement parallel to the rails, each of the carriages being selectively operative to engage a respective end of the reel spool such that the reel spool moves with the carriages along the rails, a drive (136) for selectively engaging and rotating the reel spool when the reel spool is engaged by the carriages, and a positioning device for selectively positioning the carriages into an initial reeling position (162) in which the web is reeled onto a reel spool engaged by the carriages and in which the upper run of the belt is in nipping engagement (N2) with the web being wound onto the reel spool, and positioning the carriages downstream of the initial reeling position to control the nip pressure between the belt and the web being wound onto the reel spool during reeling of the wound web roll, whereby the wound web roll is moved downstream while being horizontally supported by the rails, rotatably driven by the drive, and nipped by the belt until the desired web roll diameter is reached.

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METHOD AND APPARATUS FOR REELING A TRAVELING PAPER WEB

BACKGROUND OF THE INVENTION

The invention relates to the reeling of a traveling web of paper, such as that which is being continuously produced by a papermaking machine, continuously onto successive reel spools to produce a corresponding succession of relatively large diameter wound paper web rolls. More particularly, the invention relates to a method and apparatus for continuously producing a wound paper web roll without transferring the wound web roll from one nip actuating apparatus to another.

Two known reeling apparatus of this type are Beloit Corporation's TNT™ and ATR™ reels. The former is disclosed in U.S Patent No. 5,370,327, and the latter is disclosed in U.S Patent Application No. 08/574,824 filed December 19, 1995.

The ATR (Advanced Tissue Reel) reel was developed with a view to apply all the advantages of the TNT (Tension, Nip and Torque) reel to high bulk grades of paper, especially tissue. These grades of paper require winding at little or no nip pressure so that as much of their inherent bulk can be retained as possible. In order to attain control of very low nips, the ATR reel utilizes a large diameter reel drum on a fixed stand. Also, hydraulically controlled carriages which act as nip load controllers hold the building roll of paper against the reel drum. The nip load is measured either via load cells under the reel drum or via pressure transducers in the hydraulic carriage loading system.

The ATR reel differs from the TNT reel in that with the TNT reel, the reel drum can be raised or lowered in elevation. This allows the paper to be transferred to the new reel spool on the wet-end side of the reel drum (upstream in the paper machine process). After winding of the paper begins, the reel spool/winding roll of paper is moved downstream by its guiding

carriages. This movement requires the reel drum to move downwards to allow the winding roll of paper over the top of the reel drum. As the reel drum is of considerable weight, there is a limit to how accurately the nip can be controlled at low nip loading values while also having a large moving mass controlling the nip.

It was decided that if the reel drum was fixed on stands (i.e., its weight is supported) and the weight of the winding roll of paper is also supported on rails, then it would be easier to attain control of nip pressure at very low levels. The problem with fixing the reel drum in position is that the whole roll winding process must now happen on the dry-end side (downstream) of the reel drum in order for any component of the nip load from being provided by the weight of the new reel spool and any web wrapped on it. This means that to allow reeling to be a continuous process, the new reel spool must at some stage be inserted between the winding roll of paper and the reel drum without breaking the sheet of paper as it winds onto the roll.

It was found that if a reel drum of 2,130 mm diameter were used with a reel spool of up to 500 mm diameter then the new reel spool could be inserted into the gap between the winding roll of paper and the reel drum at any time after the winding roll of paper exceeds 2000 mm in diameter. This was made possible by placing the reel spool support rails at such a height that the empty reel spool first contacts the reel drum at a nip point 14 degrees past top-dead-center of the reel drum. This system is applicable to any reel where the reel spool is 500 mm or less in diameter, and where the particular reeling process allows for full sheet transfer of paper from the old roll of paper to the new reel spool only when the old roll of paper is above 2000 mm diameter. Below 2000 mm diameter, the sheet must be broken back from the reel to the last stage in the papermaking process and fed through again onto the new reel spool when it is in position.

SUMMARY OF THE INVENTION

One method of overcoming the above limitation is to replace the large reel drum with a fabric belt system. The belt is supported, tensioned and guided with one part of the belt run suspended at an angle chosen to suit the reeling process. It is this angled section of belt against which the winding roll of paper is "nipped". The nip pressure is measured and controlled by sensing changes in belt tension, for example by mounting one or more of the support rolls on tension load cells.

The reel spool guiding carriages will be driven/positioned by a control system (e.g. hydraulic cylinders operating in load control). Thus, as the paper diameter wound onto the reel spool increases, nip pressure increases and the reel spool carriages move downstream in order to bring the nip pressure back to the pre-determined set-point value. Because the belt is suspended at an angle, the winding roll of paper is moved further downstream from its initial position than when nipped against a reel drum whose surface is curved.

Due to the flexible nature of the belt, the nip width is wider and thus the nip intensity lower than with a hard roll. This minimizes loss of bulk in the paper.

Using a belt as described above also makes it possible to increase the size of the reel spool that can be used with low bulk grades of paper. Instead of placing load cells under a large diameter reel drum, low nips can be sensed by measuring changes in belt tension.

More particularly, the invention provides an apparatus comprising a frame and first and second generally parallel, generally horizontal rails mounted on the frame. Each rail has an upper surface for supporting a respective end of a reel spool. The apparatus also comprises a support belt mounted on the frame for movement along an endless path, the belt having an upper run extending horizontally in the cross machine direction and extending

at a non-horizontal angle in the machine direction such that the upper run is angled downwardly in the downstream direction. First and second carriages are operatively associated with the first and second rails, respectively, for longitudinal movement parallel to the rails. Each of the carriages is selectively operative to engage a respective end of the reel spool such that the reel spool moves with the carriages along the rails. A drive selectively engages and rotates the reel spool when the reel spool is engaged by the carriages. The apparatus also comprises a positioning device for (1) selectively positioning the carriages in an initial reeling position in which the web is reeled onto the reel spool engaged by the carriages and in which the upper run of the belt is in nipping engagement with the web being wound onto the reel spool, and (2) positioning the carriages downstream of the initial reeling position to control the nip pressure between the belt and the web being wound onto the reel spool during reeling of the wound web roll, whereby the wound web roll is moved downstream while being horizontally supported by the rails, rotatably driven by the drive, and nipped by the belt until the desired web roll diameter is reached.

The invention also provides a method for reeling a traveling paper web into a wound web roll on a reel spool, the method comprising the steps of: (a) supporting the reel spool for rotation and for translational movement generally horizontally; (b) rotating the reel spool so as to wind the traveling web onto the reel spool to form thereon a wound web roll; (c) providing a support belt mounted for movement along an endless path, the belt having an upper run extending horizontally in the cross machine direction and extending at a non-horizontal angle in the machine direction such that the upper run extends downwardly in the downstream direction; (d) placing the upper run of the belt in nipping engagement with the web being wound onto the reel spool; (e) maintaining horizontal support and rotation of the wound web roll and nipping engagement of the roll by the belt as the diameter of the roll increases and the roll moves downstream along the belt; and (f) controlling the nip pressure between the belt and the web being wound onto the reel spool during reeling of the wound web roll and movement of the roll along the belt.

Other features and advantages of the invention will become apparent to those skilled in the art upon review of the following detailed description, claims and drawings.

DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side elevational view of an apparatus embodying the invention.

Fig. 2 is a view showing movement of the wound web roll along the belt.

Fig. 3 is a top plan view of the apparatus.

Fig. 4 is a view taken along line 4--4 in Fig. 1.

Before one embodiment of the invention is explained in detail, it is to be understood that the invention is not limited in its application to the details of the construction and the arrangements of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DESCRIPTION OF THE PREFERRED EMBODIMENT

An apparatus **10** embodying the invention is shown in the drawings. The apparatus **10**, which reels a traveling paper web **14** into a wound web roll **18** on a reel spool **22**, has a machine direction (from right to left in Fig. 1) and a cross machine direction (into and out of the paper in Fig. 1 and from right to left in Fig. 3). Many of the components of the apparatus **10** are substantially identical to components of, and are described in greater detail in, pending U.S. Patent Application Serial No. 08/574,824, which is assigned to the assignee hereof and which is incorporated herein by reference.

The apparatus **10** comprises a frame **26** supporting a pair of spaced, parallel, horizontal rails **30** and **34**. Each of the rails **30** and **34** has a horizontal

upper surface **38** for supporting a respective end of a reel spool **22**. The apparatus **10** has front and back sides (the right and left sides in Fig. 3), with the front side being shown in Fig. 1. The front and back sides are substantially identical, and only the components of the front side are shown in detail in Fig. 1, it being understood that the corresponding components of the back side of the apparatus **10** are substantially identical.

Referring to Fig. 1, a storage station **42** is mounted on the frame **26** above the right end of the rails **30** and **34**. The storage station **42** includes a storage rack **46** for storing a supply of new reel spools **22**, and a pair of spool arms **50** (only one is shown) mounted on the frame **26** below the rack **46** for pivotal movement between a spool receiving position (shown in Fig. 1) and a spool depositing position (not shown). In the spool receiving position, the arms **50** receive a new spool **22** from the storage rack **46**. In the spool depositing position, the arms **50** deposit the new spool **22** on the upper surfaces **38** of the rails **30** and **34**.

The apparatus **10** also comprises a support belt **54** mounted on the frame **26** for movement along an endless path. The belt **54** is preferably made of a porous, low stretch fabric such as, for example, dryer felt. The belt **54** is supported on rolls **58, 62, 66, 70** and **74**, each of which is mounted on the frame **26** for rotation about a respective horizontal axis extending in the cross machine direction. The belt **54** has a generally linear upper run **78** that extends horizontally in the cross machine direction and is angled downwardly in the downstream direction. In other words, the upper run **78** extends at a non-horizontal angle in the machine direction, as generally designated by arrow **20**. A drive **82** is operably connected to the roll **70** for moving the belt **54** along its endless path such that the belt upper run moves from right to left in Fig. 1, i.e., in the direction of arrow **79** corresponding to the rotational direction of the wound roll **18**, shown by arrow **19**, at the point of engagement between the belt **54** and the roll **18**. Any suitable drive can be employed.

The roll **74** is preferably a vacuum roll. The vacuum roll **74** resists web floating, i.e., helps keep the web **14** in place. A belt tension assembly **86** controls the tension of the belt **54**. The belt tension assembly **86** includes the roll **66**, which is preferably a tension roll mounted on tension load cells **90** (shown schematically). The roll **66** is loaded against the belt **54** at a controlled tension using, for example, hydraulic cylinder/piston assemblies **94**.

A belt guide assembly **98** maintains the proper position of the belt **54** on the rolls **58, 62, 66, 70** and **74**. The belt guide assembly **98** includes the roll **58**, which is, at one end (the left end in Fig. 4), fixed against translational movement but pivotable about an axis **100** perpendicular to the roll axis and to the belt upper run **78**. The other end of the roll **58** (the right end in Fig. 4 and the end shown in Fig. 1) is translationally or arcuately movable in the direction of the arrow **102** so that the roll **58** can be "skewed" to control the position of the belt **54** on the roll **58**. A suitable device, such as a hydraulic cylinder/piston assembly **106**, is connected to the free end of the roll **58** for providing the necessary skewing of the roll **58**. The belt guide assembly **98** also includes a guide palm **110** for sensing the position of the belt **54** in the cross machine direction. The guide palm **110** is operably connected to the hydraulic assembly **106** for controlling skewing of the roll **58**. This provides a closed loop control of the belt position on the roll **58**. Such a belt guide assembly is known in the art and need not be described in greater detail. See, for example, U.S. Patent No. 4,790,908, which is incorporated herein by reference.

The apparatus **10** also comprises (see Figs. 1 and 3) an outer carriage **114** mounted on the outside of the rail **30**, an inner carriage **118** mounted on the inside of the rail **30**, an inner carriage **124** mounted on the inside of the rail **34**, and an outer carriage **128** mounted on the outside of the rail **34**. Each of the carriages **114, 118, 124** and **128** is supported for longitudinal movement parallel to the rails **30** and **34**. More particularly, each of the carriages **114**,

118, 124 and **128** is supported on a respective guide **132** (see Fig. 1) for reciprocal movement along the associated rail. Each of the carriages **114, 118, 124** and **128** is selectively operative to engage the end of a reel spool **22**, as is known in the art. The carriages operate in pairs, as explained below, with the carriages **114** and **124** cooperating to engage the opposite ends of a spool **22**, and with the carriages **118** and 128 cooperating to engage the opposite ends of a different spool **22**.

The apparatus **10** further comprises (see Fig. 3) drives **136** and **140**, each of which is operable to selectively engage and rotate a reel spool **22** when the reel spool **22** is engaged by a pair of the carriages. More particularly, the drive **136** engages and rotates a spool **22** engaged by the carriages **114** and **124**, and the drive **140** engages and rotates a spool **22** engaged by the carriages **118** and **128**. Each of the drives **136** and **140** is supported for movement parallel to the rails **30** and **34** and with the engaged reel spool **22**. A suitable drive arrangement is disclosed in U.S. Patent No. 5,370,327, which is incorporated herein by reference.

The apparatus **10** further comprises a positioning device for selectively positioning the carriages **114, 118, 124** and **128** relative to the rails **30** and **34**. The positioning device preferably includes (see Fig. 3) extendable linkages **144, 148, 154** and **158** (partially shown) connected between the frame **26** and the carriages **114, 118, 124** and **128**, respectively. In the illustrated construction, the linkages **144, 148, 154** and **158** are hydraulic cylinder/piston apparatus. Other suitable linkages, such as ball screw and chain and sprocket apparatus, can be employed. The hydraulic apparatus **144, 148, 154** and **158** are controlled such that, as described above, the carriage **114** is operatively linked with and moves with the carriage **124**, and the carriage **118** is operatively linked with and moves with the carriage **128**. In this manner, two sets of cooperating pairs of carriages are operative to move two reel spools **22**,

22' along the rails **30** and **34**. The operation of the hydraulic apparatus **144** and **154** and the associated carriage pair will be described first.

The hydraulic apparatus **144** and **154** are operable to position the carriages **114** and **124** in an initial reeling position (indicated by reference numeral 162 in Figs. 1 and 2) in which the carriages **114** and **124** receive a reel spool **22** deposited on the rails **30** and **34** by the storage station **42**, in which the web **14** is thereafter brought into nipping engagement N1 with a fresh reel spool **22** and reeled onto the reel spool **22** engaged by the carriages **114** and **124**, and in which the upper run of the belt **54** is in nipping engagement with the web **14** at nip N2 being wound onto the reel spool **22**. The paper web **14** travels over the right or upper end of the belt **54** and down the upper run of the belt before being reeled onto the reel spool **22**. A paper web tail guiding apparatus **166** (Fig. 1) is mounted on the frame **26** and guides the oncoming paper web tail in the direction of arrow **15** onto the belt **54**.

The hydraulic apparatus **144** and **154** thereafter position the carriages **114** and **124** downstream of the initial reeling position to control the nip pressure between the belt **54** and the web **14** being wound onto the reel spool **22** during reeling of the wound web roll **18**. A controller **170** (shown schematically in Fig. 1) senses the nip pressure between the belt **54** and the wound web roll **18** and controls the hydraulic apparatus **144** and **154** so as to adjust the nip pressure. More particularly, in the illustrated construction, the load cells **90** sense the tension in the belt **54** and thereby sense the nip pressure. Any tension increase due to nip between the roll **18** and the belt **54** is sensed by the load cells **90** and used to control the hydraulic apparatus **144** and **154.**

The controller **170** preferably also includes a device **171** for sensing the position of the carriages **114, 118, 124** and **128**, the carriage position being indicative of the diameter of the wound web roll **18**. In the illustrated

construction, each of the hydraulic apparatus **144, 148, 154** and **158** (i.e., positioning devices) has a built-in linear variable displacement transducer (LVDT) that indicates roll diameter. The roll diameter can be used to control the drive speed profile/nip profile throughout the buildup of the roll.

The hydraulic apparatus **144** and **154** are also operable to position the carriages **114** and **124** to move the wound web roll **18** out of nipping engagement with the belt **54** (to the left of the belt **54** in Fig. 1) when the desired web roll diameter is reached. The wound web roll **18** is then removed from the carriages **114** and **124** and from the apparatus **10**, as is known in the art.

Thus, the wound web roll **18** is moved downstream in the direction of arrow **20** while being horizontally supported by the rails **30** and **34**, rotatably driven by the drive **136**, and nipped by the belt **54** until the desired web roll diameter is reached.

The hydraulic apparatus **148** and **158** are operable in the same manner as the hydraulic apparatus **144** and **154**. After the carriages **114** and **124** move downstream from the initial position, the hydraulic apparatus **148** and **158** position the carriages **118** and **128** in the initial position to receive the next reel spool **22'** deposited by the storage station **42**. After the preceding reel spool **22** (engaged by the carriages **114** and **124**) moves downstream of the belt **54**, the arms **50** deposit the next spool **22'** on the rails **30** and **34** in engagement with the carriages **118** and **128**, and the hydraulic apparatus **148** and **158** move the carriages **118** and **128** in the same manner as described above. The wound web roll **18** is then removed from the carriages **114** and **124**, and the hydraulic apparatus **144** and 154 return the carriages **114** and **124** to the initial position to receive the next reel spool **22'**.

Various features of the invention are set forth in the following claims.

I CLAIM:

1. Apparatus for reeling a traveling paper web **(14)** into a wound web roll **(18)** on a reel spool **(22)** having opposite ends, the apparatus having machine and cross machine directions and upstream and downstream directions, the apparatus comprising

a frame **(26)**,

first and second generally parallel, generally horizontal rails **(30,34)** mounted on the frame, each rail having an upper surface **(38)** for supporting a respective end of the reel spool,

a support belt **(54)** mounted on the frame for movement along an endless path, the belt having an upper run **(78)** extending horizontally in the cross machine direction and extending at a non-horizontal angle in the machine direction such that the upper run extends downwardly in the downstream direction,

a drive **(136)** for selectively engaging and rotating the reel spool when the reel spool is supported by the rails, and

a positioning device **(144,154)** for selectively positioning the reel spool **(22)** in an initial reeling position **(162)** in which the web is reeled onto the reel spool and in which the upper run **(78)** of the belt is in nipping engagement with the web being wound onto the reel spool, and positioning the reel spool downstream of the initial reeling position to control the nip pressure between the belt **(54)** and the web **(14)** being wound onto the reel spool during reeling of the wound web roll, whereby the wound web roll **(18)** is moved downstream while being horizontally supported by the rails, rotatably driven by the drive, and nipped by the belt until the desired web roll diameter is reached.

2. Apparatus as set forth in claim 1 and further comprising a drive **(82)** for moving the belt along the endless path such that the belt upper run moves in the direction **(79)** of the wound roll **(19)** at the nip point of engagement N2 between the belt and the wound web roll.

3. Apparatus as set forth in claim 1 wherein the positioning device includes first and second extendable linkages **(144,154)**.

4. Apparatus as set forth in claim 3 wherein the linkages are hydraulic cylinder/piston apparatus.

5. Apparatus as set forth in claim 1 and further comprising a controller **(170)** for sensing the nip pressure between the belt and the wound web roll, and for controlling the positioning device so as to adjust the nip pressure.

6. Apparatus as set forth in claim 5 wherein the controller senses the tension in the belt, the tension being indicative of nip pressure.

7. Apparatus as set forth in claim 6 and further comprising a belt tension assembly **(86)**, and wherein the controller senses the force exerted on the belt by the belt tension assembly, the force being indicative of nip pressure.

8. Apparatus as set forth in claim 7 wherein the belt tension assembly includes a tension roll **(66)** partially supporting the belt **(54)** for movement along the endless path, and a hydraulic cylinder/piston apparatus **(94)** exerting a force on the tension roll so as to tension the belt, and wherein the controller includes a load cell **(90)** supporting the tension roll.

9. Apparatus as set forth in claim 5 and further comprising first and second carriages **(114,124)** operatively associated with the first and second rails **(30,34)**, respectively, for longitudinal movement parallel to the rails, each

of the carriages being selectively operative to engage a respective end of the reel spool such that the reel spool moves with the carriages along the rails, and wherein the controller **(170)** includes a device **(171)** for sensing the position of at least one of the carriages, said position being indicative of the diameter of the roll.

10. Apparatus as set forth in claim 1 and further comprising a belt guide assembly **(98)**.

11. Apparatus as set forth in claim 10 wherein the belt guide assembly includes a guide roll **(59)** partially supporting the belt for movement along the endless path, a guide palm **(110)** for sensing the position of the belt in the cross-machine direction, and a device **(106)** for skewing the guide roll to control the position of the belt.

12. Apparatus as set forth in claim 1 and further comprising first and second carriages **(114,124)** operatively associated with the first and second rails, respectively, for longitudinal movement parallel to the rails, each of the carriages being selectively operative to engage a respective end of the reel spool such that the reel spool moves with the carriages along the rails, and a storage station **(42)** for storing new reel spools, and a reel spool loading device **(50)** for moving a new reel spool from the storage station into engagement with the carriages.

13. Apparatus as set forth in claim 1 and further comprising first and second carriages **(114,124)** operatively associated with the first and second rails **(30,34)**, respectively, for longitudinal movement parallel to the rails, each of the carriages being selectively operative to engage a respective end of the reel spool **(22)** such that the reel spool moves with the carriages along the rails, wherein the drive selectively engages and rotates the reel spool when the reel spool is engaged by the carriages, and wherein the positioning device

(144,154) selectively positions the carriages in an initial reeling position **(162)** in which the web is reeled onto the reel spool engaged by the carriages and in which the upper run of the belt **(54)** is in nipping engagement (N1,N2) with the web **(14)** being wound onto the reel spool, and positions the carriages downstream of the initial reeling position to control the nip pressure (N2) between the belt and the web being wound onto the reel spool during reeling of the wound web roll.

14. Apparatus as set forth in claim 13 and further comprising third and fourth carriages **(118,128)** operatively associated with the first and second rails **(30,34)**, respectively, for longitudinal movement parallel to the rails, each of the third and fourth carriages being selectively operative to engage a respective end of a reel spool such that the reel spool engaged by the third and fourth carriages moves with the third and fourth carriages along the rails, and a second positioning device **(148,158)** for selectively positioning the third and fourth carriages in an initial reeling position **(162)** in which the web is reeled onto the reel spool engaged by the third and fourth carriages and in which the upper run **(78)** of the belt is in nipping engagement with the web being wound onto the reel spool, and positioning the third and fourth carriages downstream of the initial reeling position to control the nip pressure (N2) between the belt and the web being wound onto the reel spool during reeling of the wound web roll, whereby the wound web roll is moved downstream while being horizontally supported by the rails, rotatably driven by the drive, and nipped by the belt until the desired web roll diameter is reached.

15. Apparatus as set forth in claim 14 wherein each of the rails **(30,34)** has opposite sides, wherein the first carriage **(114)** moves along one side of the first rail **(30)**, wherein the third carriage **(118)** moves along the other side of the first rail, wherein the second carriage **(124)** moves along one side of the second rail **(34)**, and wherein the fourth carriage **(128)** moves along the other side of the second rail **(34)**.

16. Apparatus as set forth in claim 1 wherein the upper run **(78)** of the belt is generally linear.

17. Apparatus as set forth in claim 1 wherein the positioning device **(144,154)** also selectively positions the wound web roll out of nipping engagement with the belt.

18. A method for reeling a traveling paper web **(14)** into a wound web roll **(18)** on a reel spool **(22)**, the method utilizing apparatus having machine and cross machine directions and upstream and downstream directions, the method comprising the steps of

(a) supporting **(30,34)** the reel spool **(22)** for rotation and for translational movement **(20)** generally horizontally,

(b) rotating **(136)** the reel spool so as to wind the traveling web onto the reel spool to form thereon a wound web roll,

(c) providing a support belt **(54)** mounted for movement along an endless path, the belt having an upper run **(78)** extending horizontally in the cross machine direction and extending **(79)** at a non-horizontal angle in the machine direction such that the upper run extends downwardly in the downstream direction,

(d) placing the upper run of the belt in nipping engagement (N1) with the web being wound onto the reel spool,

(e) maintaining horizontal support and rotation of the wound web roll and nipping engagement (N2) of the wound web roll by the belt as the diameter of the roll increases and the roll moves downstream **(20)** along the belt, and

(f) controlling **(170,171,90)** the nip pressure between the belt and the web being wound onto the reel spool during reeling of the wound web roll and movement of the roll along the belt.

19. A method as set forth in claim 18 and further comprising the step of driving the belt along the endless path such that the belt upper run moves **(79)**

in the direction of the wound roll at the nip point of engagement (N2) between the belt and the roll.

20. A method as set forth in claim 18 wherein step (f) includes sensing the tension **(86)** in the belt, the tension being indicative of nip pressure (N1,N2).

21. A method as set forth in claim 18 and further comprising the step of moving **(144,154;148,158)** the wound web roll **(18)** out of nipping engagement with the belt when the desired web roll diameter is reached.

22. A method as set forth in claim 18 wherein steps (b) and (d) are performed by placing the upper run **(78)** of the belt in nipping engagement (N2) with the reel spool, and directing the traveling web into the nip between the reel spool and the belt.

23. A method as set forth in claim 18 and further comprising the steps of supporting a second reel spool **(22')** for rotation and for translational movement generally horizontally, rotating **(140)** the second reel spool, transferring the web onto the second reel spool so as to wind the traveling web onto the second reel spool, and placing the upper run of the belt in nipping engagement with the web being wound onto the second reel spool.

24. A method as set forth in claim 23 and further comprising the steps of moving the wound web roll on the first-mentioned reel spool **(22)** out of nipping engagement with the belt when the desired web roll diameter is reached, and removing the wound web roll **(18)** on the first-mentioned reel spool **(22)** from horizontal support while the web is wound onto the second reel spool **(22')**.

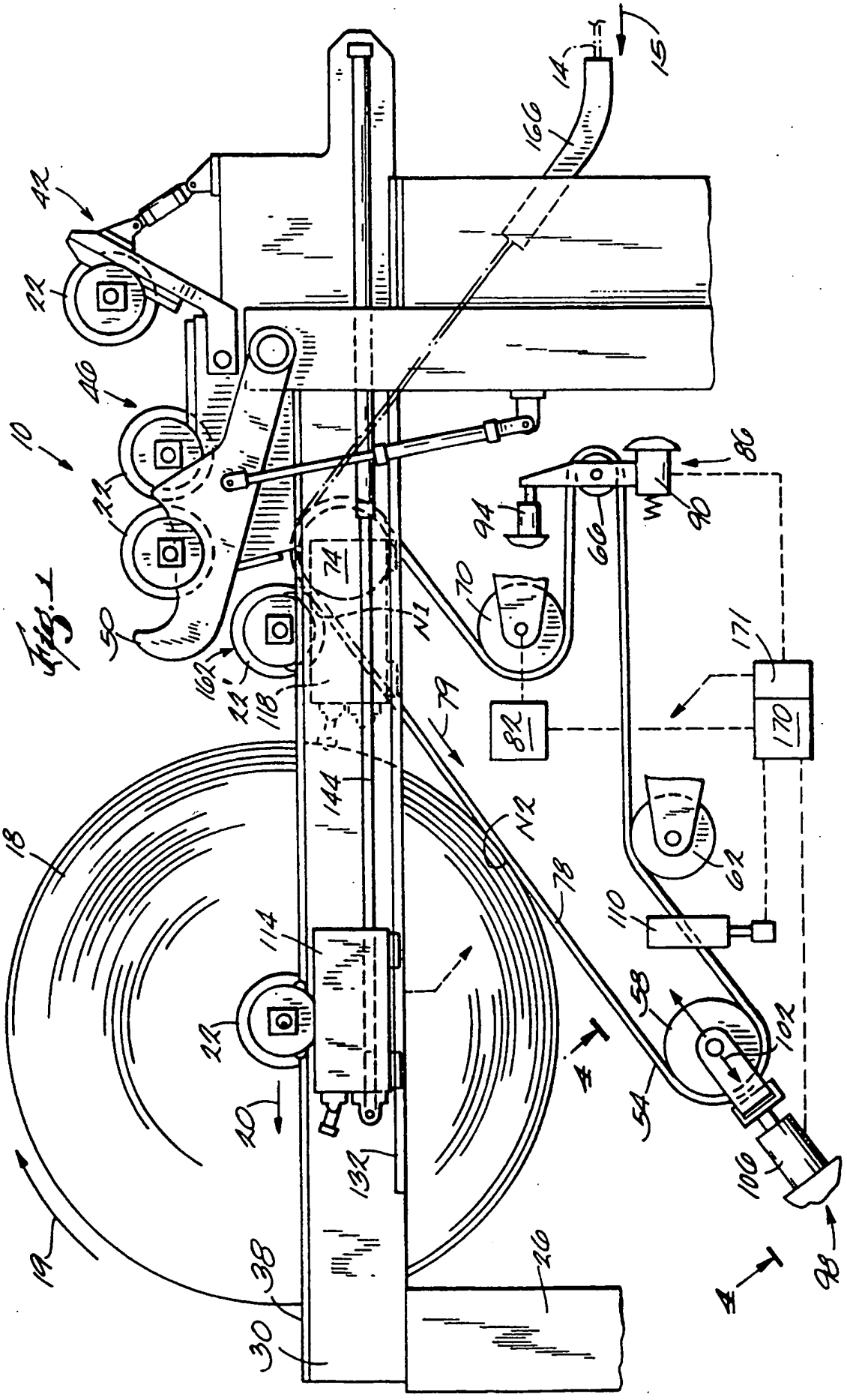
Fig. 1
10
12
14
15
16
18
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22
30
38
42
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62
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66
70
74
78
79
80
82
86
90
94
98
100
102
106
110
114
118
120
122
132
144
166
170
171
N1
N2
W

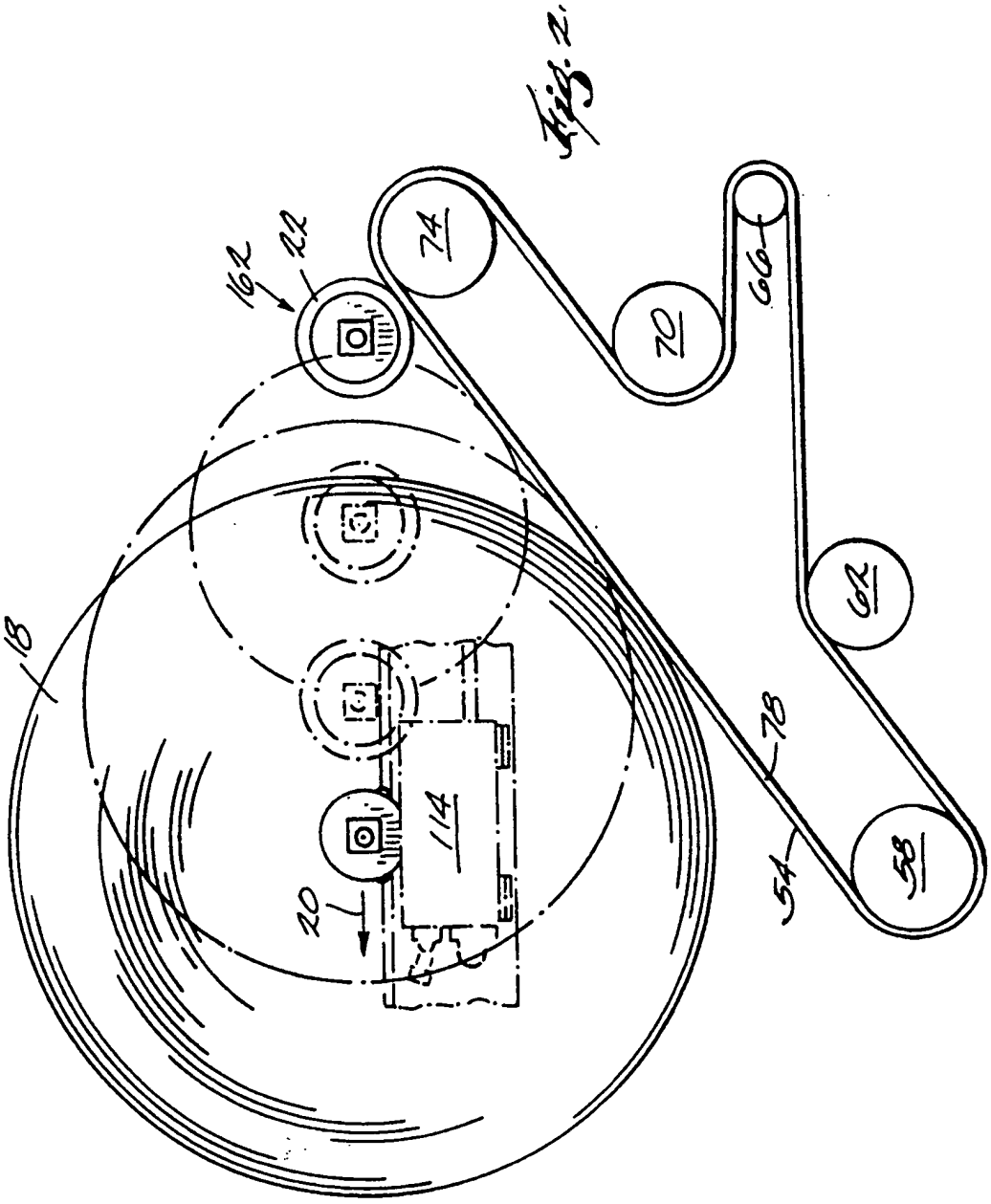
Fig. 2.
16
22
74
70
66
62
78
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58
18
114
20

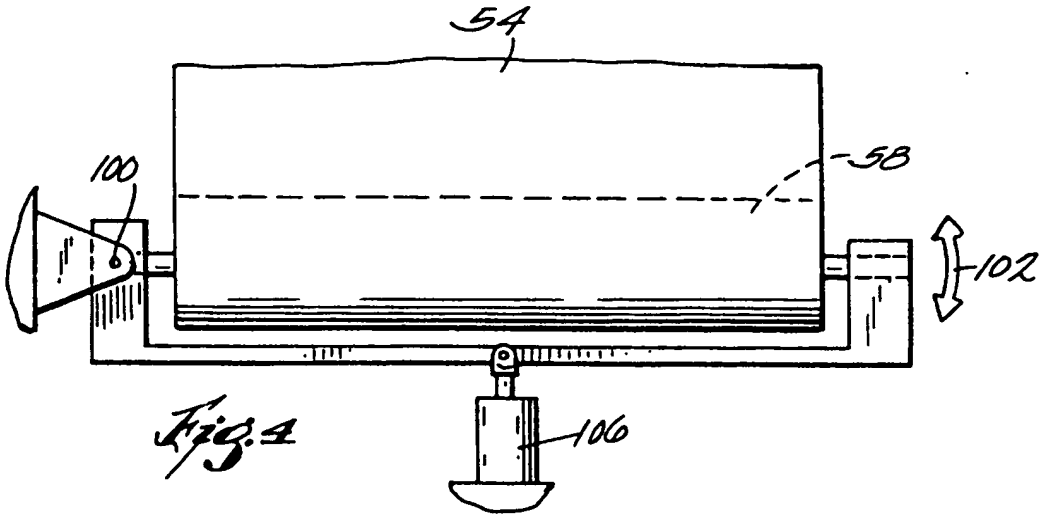
54
100
58
102
106

Fig. 4

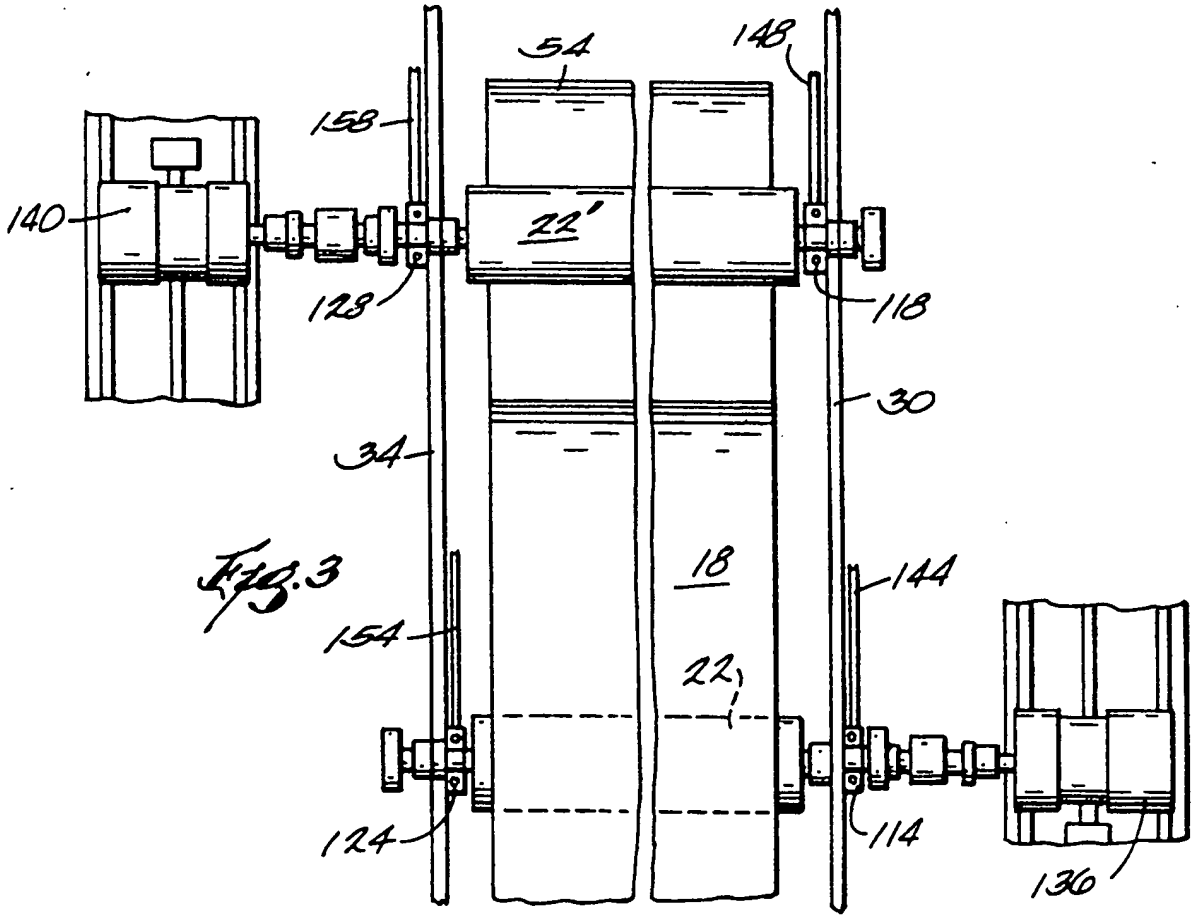
54
148
158
140
22'
128
118
30
34
18
144
154
22
124
114
136

Fig. 3

INTERNATIONAL SEARCH REPORT

Inte: ...ional Application No
PCT/EP 97/02962

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B65H18/26 B65H18/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B65H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 370 327 A (B. C. ADAMSKI) 6 December 1994 cited in the application see the whole document	1,3,4,9, 12-15, 17,18, 21-23
A	WO 97 01502 A (VOITH SULZER PAPIERMASCHINEN GMBH) 16 January 1997 see page 9, paragraph 3 - page 10; figures 8-10	1,2,16, 18,19,22
A	EP 0 658 504 A (VALMET PAPER MACHINERY INC.) 21 June 1995 see column 5, line 21 - column 7, line 27; figures 1-5	1,2,18, 19,22-24

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 February 1998	17/02/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Raven, P

Form PCT/ISA/210 (...) (July 1992)

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